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A HYDROLOGY AND HYDRAULIC CASE STUDY ON JANUARY 2015 FLASH FLOOD IN UNIGARDEN, KOTA SAMARAHAN, SARAWAK

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ABSTRACT

This study investigated the possible causes for occurrence of flash flood in UniGarden by looking into the hydrologic and hydraulic factors. This study consists of the assessment of water balance (precipitation, surface runoff, and infiltration) as well as the suitability of the hydraulic capacity of the existing earth drain based on MSMA guidelines. The site works involved analysis on precipitation, measurements of size of the earth drain and the corresponding flow velocity, and water quality testing. The consistency in annual rainfall and comparison between storm in year 2007 and 2015 indicated that precipitation was not the main cause of the flash flood. The infiltration of both storm events were limited due to precipitation few days prior to the extreme storm event that partially saturated the previous ground. There was a 45% increase in the average peak flow in 2015 than that in 2007. The TSS in both low flow and high flow were relatively low, providing estimated sediment loading up to 84.81 g d^{-1}, which is not likely to have a direct effect on reducing the earth drain size. Rapid vegetation growth slow down flow, reduced free flow area of the earth drain, thus decreased its hydraulic capacity. Lowest invert level point of the drain was found to be located some distance away from the outlet, indicating potential backflow of water. These findings suggests that the increase in runoff, decrease in hydraulic capacity, and the improper invert level of the earth drain contributed to the flash flood in UniGarden on 18 January 2015. This finding is essential in providing insight to the incident as well as call for consistency review of drainage network in land development policy and decision making.

Keywords: Drainage design; hydraulic capacity; vegetation; water balance.

1 INTRODUCTION

Flash flood affects the lives of people and environment by disrupting the mobility of residents, damaging infrastructures, and endanger public health and safety. Flash flood is also a strong indication for hydrological review of a catchment area, especially developed for area with proper drainage system. Therefore, this study was conducted to investigate the cause of flash flood in UniGarden on 18 January 2015. The accumulation of the surface water in the main earth drain preceded the flash flood. It was observed that the excess surface water overflow from the main earth drain towards the apartment and commercial areas (Figure 1a, b), give rise to submergence of the main access road (Figure 1b) and nearby compounds. The accumulation of surface water was observed during and after the storm (Figure 1c, d).

In this study, the flash flood is reviewed based on 5 areas of study, namely on precipitation, surface runoff, sedimentation, vegetation growth, and drainage design. It is anticipated that, should the intensity of precipitation increases, the runoff generated is more significant as the ground is fully saturated with water and all excessive precipitation is turned into runoff (Yuan et al., 2015) and hence precipitation should be studied. Ground cover and land use also directly influences the occurrence of flash flood. Rapid developments and removal of vegetation and protective layers from the earth result in generation of greater runoff volume as the impervious ground surface increases and the soil become more compact. The runoff also travel with higher velocity on bare surfaces such as bare earth and impervious surfaces. All these contributes to larger peak flow and result in a flash flood (University Corporation for Atmospheric Research, 2010) and hence should be studied. The main purpose of drainage system in a developed or urbanized area is to convey the excessive runoff from the area to the outlet in a timely and hygienic manner. It must be capable of either rapid removal of excess surface runoff, storage on site, or temporary detention and hence its design should be studied. Excessive sedimentation in the water body due to heightened sediment loading may threaten the water quality, disrupt aquatic biota and affects the hydraulic capacity of a conveyance system such as river (Bong et al., 2014; Douglas, 1995) and hence should be studied. Vegetation growth drastically influences water levels and flow patterns in lowland rivers (Doncker et al., 2009) and hence should be included in the study as well.

